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Effects of art on surgical patients: a systematic review and meta-analysis

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Abstract: **OBJECTIVES:** The aim of the study was to assess the effect of art including ambient features such as music, interior design including visual art, and architectural features on health outcomes in surgical patients. **BACKGROUND:** Healing environments can have a positive influence on many patients, but data focusing on art in surgical patients remain scarce. **METHODS:** We conducted a systematic search following the PRISMA guidelines from January 2000 to October 2014 on art in surgical patients. For music interventions, we pooled controlled studies measuring health outcomes (eg, pain, anxiety, blood pressure, and heart rate) in a meta-analysis. For other art forms (ambient and architectural features and interior design), we did a narrative review, also including nonsurgical patients, and looked for examples covering 3 countries. **RESULTS:** Our search identified 1101 hits with 48 studies focusing on art in surgical patients: 47 studies on musical intervention and 1 on sunlight. The meta-analysis of these studies disclosed significant effects for music on pain after surgery, anxiety, systolic blood pressure, and heart rate, when compared with control groups without music. Effects of music were larger with self-selected music, and lower in surgical interventions performed under general anesthesia. Interior design features such as nature images and more spacious rooms, and architectural features providing more sunlight had positive effects on anxiety and postoperative pain. **CONCLUSIONS:** Self-selected music for surgical patients is an effective and low-cost intervention to enhance well being and possibly faster recovery. Although potentially very important, the impact of environmental features and spacious architecture with wide access to sunlight remains poorly explored in surgery. Further experimental research is needed to better assess the magnitude of the impact and cost effectiveness.

DOI: <https://doi.org/10.1097/SLA.0000000000001480>

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ZORA URL: <https://doi.org/10.5167/uzh-119262>

Journal Article

Published Version

Originally published at:

Vetter, Diana; Barth, Jürgen; Uyulmaz, Sema; Uyulmaz, Semra; Vonlanthen, René; Belli, Giulio; Montorsi, Marco; Bismuth, Henri; Witt, Claudia M; Clavien, Pierre-Alain (2015). Effects of art on surgical patients: a systematic review and meta-analysis. *Annals of Surgery*, 262(5):704-713.

DOI: <https://doi.org/10.1097/SLA.0000000000001480>

Effects of Art on Surgical Patients: A Systematic Review and Meta-analysis

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Objectives: The aim of the study was to assess the effect of art including ambient features such as music, interior design including visual art, and architectural features on health outcomes in surgical patients.

Background: Healing environments can have a positive influence on many patients, but data focusing on art in surgical patients remain scarce.

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Results: Our search identified 1101 hits with 48 studies focusing on art in surgical patients: 47 studies on musical intervention and 1 on sunlight. The meta-analysis of these studies disclosed significant effects for music on pain after surgery, anxiety, systolic blood pressure, and heart rate, when compared with control groups without music. Effects of music were larger with self-selected music, and lower in surgical interventions performed under general anesthesia. Interior design features such as nature images and more spacious rooms, and architectural features providing more sunlight had positive effects on anxiety and postoperative pain.

Conclusions: Self-selected music for surgical patients is an effective and low-cost intervention to enhance well being and possibly faster recovery. Although potentially very important, the impact of environmental features and spacious architecture with wide access to sunlight remains poorly explored in surgery. Further experimental research is needed to better assess the magnitude of the impact and cost effectiveness.

Keywords: art, intervention, meta-analysis, music, pain, surgery

(*Ann Surg* 2015;262:704–713)

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.annalsofsurgery.com).

Grant support: The study was supported by Liver and Gastrointestinal Disease Foundation (<http://lgidfoundation.ch>).

Disclosures: The authors have nothing conflicts of interest.

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ISSN: 0003-4932/14/26105-0821

DOI: 10.1097/SLA.0000000000001480

Aesthetic matters

Attractive things work better

Don Norman, Designer and Author
University of California, San Diego

Surgery not only has an important physical impact on patients, but the loss of control, waiting periods for surgery, postoperative pain, and gradual recovery, as well as thoughts on temporary or lasting disability cause significant psychological stress. Although patient tolerance to surgery varies according to the extent of the intervention, many patient-related factors play a major role depending on individual stress levels, catastrophizing mechanisms, and stress-management capabilities of patients.¹

Stress responses can be assessed using standardized instruments with high reliability. Stress responses compromise patients' ability to cooperate, and can, for example, lead to sleep disruption and delay gastric emptying with a risk of broncho-aspiration.² They also increase the metabolism and oxygen consumption, as well as the probability of thromboembolic events and impair wound healing.³ The affective state of the patient (ie, anxiety and depression) alters the endocrine and metabolic function with a higher sympathetic tone, and therefore may increase heart rate and systolic blood pressure.⁴ Anxiety and pain-reducing therapies have been shown to reduce perioperative morbidity⁵ and mortality⁶ in surgical patients. Thus, other modalities reducing stress responses represent a valuable approach to improve perioperative well being.

Although the term “healing environment” is often used, it is not uniformly defined. It suggests that the physical environment of the health care setting may improve the healing process and patients' feeling of well being.^{7,8} Art should be part of a healing environment, and is also difficult, if not impossible, to define. For the purpose of this study, we understand art as architectural features, ambient features, as well as a variety of interior design features including pictures, paintings, sculptures, and so on.

Although possibly widely used and advocated, there is surprisingly little evidence for the benefit of art in surgical patients.^{9,10} Ulrich's study published in 1984 pointed out the importance of a view on trees and landscape for an improved recovery from surgery. He compared patients after cholecystectomy from one ward looking out onto trees with a group of patients from another ward looking at a brick wall, and found a significant reduction of analgesic use and earlier discharge in the group looking at the landscape.¹¹ Thus, if a change in environment can achieve such an impact, the effect of many art features and interventions on patients might also contribute to positive health outcomes.

We therefore systematically reviewed the literature from 2000 onward to compile the evidence of exposure to art divided in architectural features, interior design, or ambient features, such as music,¹² during the perioperative period. We investigated whether art can influence patients' health, as assessed by anxiety, pain, and

physiological parameters. Finally, we report on recent examples of art in medicine and surgery.

MATERIALS AND METHODS

To answer our research questions, we combined 2 approaches: (1) a systematic review and meta-analysis, mainly on music as intervention; and (2) a narrative review on other forms of art and the effect on patients.

Systematic Review and Meta-analysis

Literature Search

Our literature search aimed at controlled clinical studies investigating the role of art in surgical patients. We used PubMed and combined keywords, with text words related to surgical interventions, controlled trials, and any kind of art. The performed systematic search in PubMed from January 2000 to October 2014 resulted in 1101 references, which were stored in the reference database software EndNote X7 (Thomson Reuters, Philadelphia, PA). For the present meta-analysis, all references related to the search terms were considered for inclusion. We further hand-searched promising journals such as “Journal Health&Place” and the “Nordic Journal of Music Therapy,” both of which were negative for articles of interest. In the journal “Journal of Music Therapy,” we found 2 additional hits that were later excluded after full-text screening. One further reference on natural lighting in surgical patients¹³ was found while screening review articles.

Inclusion Criteria

We included controlled trials comparing all kinds of art, with a no-art exposure in surgical adult patients with clinically relevant outcomes including pain, anxiety, and physiological parameters. Studies available on music compared music versus no music before, during, or after surgery. The music intervention had to be within 24 hours of surgery; otherwise, it was considered as separate therapeutic intervention. In case of more than two intervention groups (eg, no music, other type of music, and white noise), we selected the groups closest to music versus no music intervention. If one dataset was published in different publications, we merged the available information into one dataset. Studies on music as part of a complex intervention strategy, such as music therapy with active participation of the patient, were excluded.

Study Selection

Following the Preferred Reporting Items of Systematic reviews and Meta-Analyses (PRISMA) guidelines (PRISMA Statement, <http://www.prisma-statement.org>), of 1101 references, titles and abstracts were identified and screened for inclusion by 4 independent coders (S.U., Sr.U., D.V., and J.B.) in Endnote version X7 with a structured manual (the manual is available on request from the corresponding author). For training purposes and interrater agreement evaluation, a random sample of 5% of all references was independently rated by all coders. The percentage of agreement for the reasons of exclusion was larger than 75%, and all raters identified the same studies for a full-text screening. During the screening, raters were able to mark references as unclear. In such cases, a definite decision was taken by consensus with a senior researcher (J.B. and D.V.). Of the 1101 screened references, 87 were of interest to us. Seventy-nine of those references were available in the full text. Each full text was screened independently for inclusion by 2 of the 4 authors (S.U., Sr.U., D.V., and J.B.) following the inclusion criteria presented above, and data were collected in Excel version 14.3.9 (Microsoft Corporation, Redmond, WA). Discrepancies were checked by a fifth coworker (I.M.), corrected, and, if

unclear, a consensus was found with a senior researcher. One study was totally¹⁴ and 4 were partially^{15–18} excluded for certain endpoints due to ambiguous statistical information. One study about the effect of sunlight on patient outcome was not included in the meta-analysis. We finally included 47 studies on perioperative music interventions in the meta-analysis (Supplemental Digital Content 1, <http://links.lww.com/SLA/A861>).^{15–61}

Outcome Measures

We looked at 3 outcome domains in our meta-analysis: first, *pain*, measured by the visual analog scale (VAS) and required pain medication; second, *anxiety*, assessed by the State-Trait Anxiety Inventory (STAI) or VAS; and third, *physiological parameters* (systolic blood pressure and heart rate). Every single outcome of interest was measured after both the surgical and the music intervention. The meta-analyses were performed for these 5 outcomes, separately.

Moderators of Treatment Effects

We extracted potential moderators for treatment effects for stratified meta-analyses. The study quality was assessed with the following three criteria: (1) blinding (adequate blinding of outcome assessors vs not/unclear); (2) intention-to-treat analysis (used vs not/unclear); and (3) randomization (adequate generation of sequence and adequate allocation of patients vs not/unclear). Clinical moderators as proxies for the extent of the surgery were as follows: (1) the type of anesthesia (local and regional vs general anesthesia); and (2) inpatient vs outpatient surgical treatment. The moderator of self-selected vs preselected music (by study personnel) was used to look at the importance of personalized music.

Analysis

Between-group effect sizes (ES) were calculated from the difference of posttreatment means of the intervention group and the control group, and dividing this difference by the pooled SD (Cohen's *d*). In case of missing information in the publication, we estimated ES according to established procedures.⁶² An ES of 0.20 indicates a small effect, 0.50 a medium effect, and 0.80 a large effect between groups.⁶³

All statistical analyses were done with STATA 12 by the command *metan* and *metareg*.⁶⁴ The reported summary statistics were calculated as random-effects models based on the assumption of heterogeneity between studies. Pooling was done according to the DerSimonian and Laird method,⁶⁵ using inverse variance of the primary studies as implemented in the command *metan* in STATA (StataCorp LP, College Station, TX).

Heterogeneity between the studies was assessed by examining forest plots of studies and through I^2 statistics. The I^2 value, ranging from 0% to 100%, indicates the magnitude of between-study heterogeneity. I^2 values of <25% indicate low, 25% to <50% moderate, and 50% to 75% high heterogeneity.⁶⁶ The presence of a publication bias was examined using funnel plots and the Egger regression test.⁶⁷

Narrative Review

PubMed was screened and we found studies on room design ($n = 5$), color ($n = 1$), light ($n = 2$), music ($n = 32$), and sound ($n = 8$), in combination with patients' health or recovery. This search was not limited to surgical patients and also did not have a time limit.

RESULTS

Systematic Review on Art and Surgery

All 47 studies included in the meta-analysis were controlled trials assessing the effect of music before ($n = 26$), during ($n = 25$), or

after ($n=25$) the surgical intervention on pain, pain medication, anxiety, blood pressure, and heart rate (Supplemental Digital Content 2, <http://links.lww.com/SLA/A861>). Music was listened to at more than one time point (before, during, and after surgery) in 21 studies. Twenty studies were conducted in an inpatient setting, 18 in an outpatient setting, whereas 9 studies provided no reliable information about the setting. In 18 studies, patients received general anesthesia only and in 12 studies, local or regional anesthesia. Nine studies included patients with a combination of general and local anesthesia. One study did not apply any anesthesia, and 7 studies provided unclear information on the type of anesthesia (Supplemental Digital Content 2, <http://links.lww.com/SLA/A861>). Information on basic analgesia and medication like daily intake of acetaminophen or opioids was only given in 14 (30%) of the 47 studies, and only 1 of these 14 studies included patients with basic analgesia, but matched their patients for basic analgesia intake. In 17 (36%) of 47 studies, music was preselected by the study designers; in the remaining 30 studies, patients selected music from a provided collection of music ($n=25$) or brought their own music ($n=5$) (Supplemental Digital Content 2, <http://links.lww.com/SLA/A861>). Thirty studies assessed pain, of which 4 focused on the use of medication, 17 assessed pain through VAS only, and 9 studies addressed both pain medication and VAS score. Thirty-one studies looked at the effect of music on anxiety. This was measured either by STAI ($n=16$), VAS ($n=7$), or both VAS and STAI ($n=3$). Five studies did not report how anxiety was measured, and were therefore excluded for this analysis. Physiological parameters such as systolic blood pressure or heart rate were assessed in 30 of these studies (Supplemental Digital Content 2, <http://links.lww.com/SLA/A861>). Only few studies additionally looked at laboratory parameters ($n=13$) or hospital stay ($n=7$).

Overall Effectiveness of Perioperative Music on Pain, Anxiety, and Physiological Parameters

Music was effective to reduce pain after surgery ($ES = -0.31$, 95% confidence interval (CI) -0.46 to -0.17 , $I^2 = 62.7\%$), and consequently pain medication was lower in patients who were exposed to music ($ES = -0.28$, 95% CI -0.45 to -0.11 , $I^2 = 38.2\%$) (Fig. 1). Additional data for all analyses are available from the authors. The effect of music on anxiety was similar

($ES = -0.34$, 95% CI -0.51 to -0.17 , $I^2 = 63.9\%$). Systolic blood pressure was reduced in patients receiving a music intervention ($ES = -0.40$, 95% CI -0.59 to -0.21 , $I^2 = 76.8\%$), and also heart rate ($ES = -0.27$, 95% CI -0.44 to -0.10 , $I^2 = 75.6\%$) (Fig. 1).

In summary, all outcomes were improved with a significant clinical effect of about -0.30 by music intervention compared with controls without music intervention. However, the ES between studies varied considerably (moderate-to-large heterogeneity), and we therefore grouped the studies according to study characteristics (ie, methodological quality, clinical characteristics) to see whether differences in effects can be explained by these characteristics.

Effectiveness of Perioperative Music According to Methodological Quality

The quality of the studies according to our three quality indicators showed some problems in study design or reporting. Thirteen of the 47 studies reported adequate blinding of outcome assessors, but only 2 of the 47 studies mentioned the use of an intent-to-treat analysis. Thirty-nine (83%) of the 47 studies did a proper randomization with an externally generated randomization sheet and without any possibility to foresee the allocation of the next patient. In reality, the study might have used proper methodology, but the reporting quality of the study was low. The use of Consolidated Standards of Reporting Trials (CONSORT) criteria⁶⁸ would be highly desirable for the reporting of studies on art in surgery, and the problem of missing data and blinding of outcome assessors requires further attention.

Stratified Analysis for Clinical Characteristics of the Surgical Procedure

We meta-analyzed the studies stratified for 2 clinical characteristics as proxies for the severity of the surgical intervention: (1) studies using general anesthesia were compared to studies using other type of anesthesia; and (2) studies using music in inpatient or outpatient setting were compared.

The positive effect of perioperative music on pain, as measured by VAS, persisted in studies where surgery was performed under general anesthesia ($ES = -0.29$, 95% CI -0.46 to -0.12). However, the effect on pain medication substantially decreased

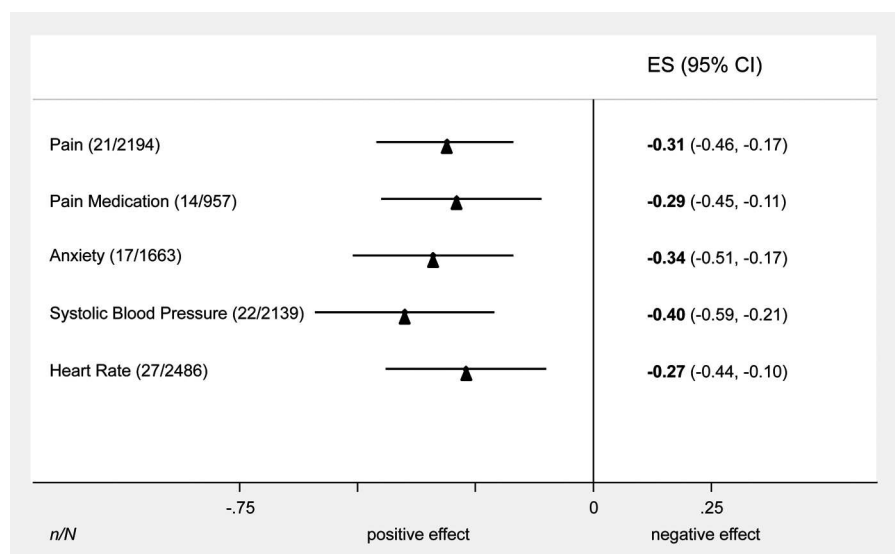
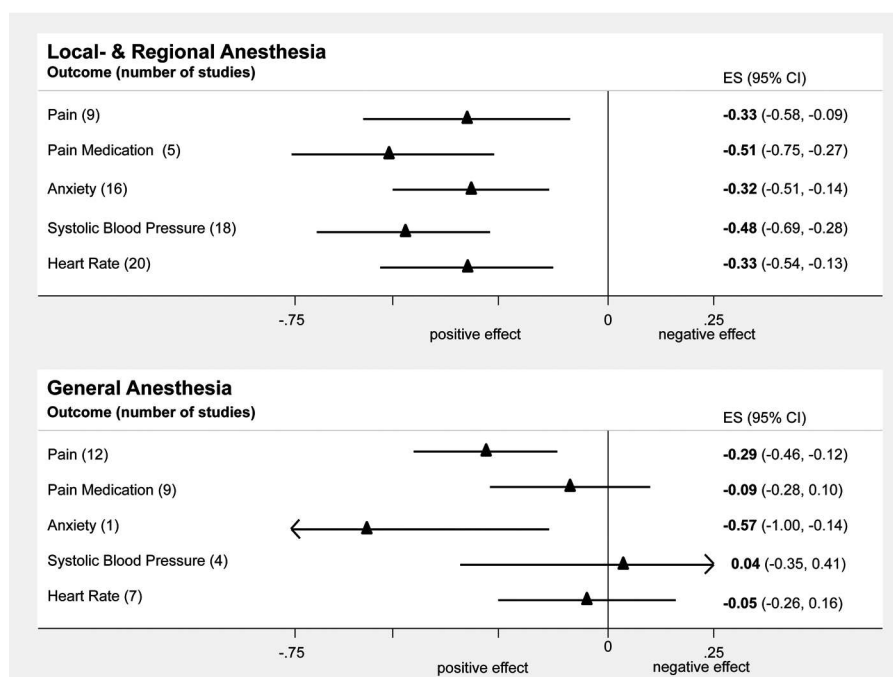


FIGURE 1. Perioperative music has a positive effect on pain, anxiety, and physiological parameters. This figure summarizes the findings of the meta-analysis on perioperative music on pain, anxiety, and physiological parameters after surgery. Music was effective to reduce pain and consequently decreased the demand for pain medication. The effect of music on anxiety was similar. Further, systolic blood pressure and heart rate were reduced in patients receiving a music intervention.

FIGURE 2. Perioperative music for patients with general anesthesia has a lower effect on pain medication requirement and physiological parameters. This figure summarizes the findings of the meta-analysis on perioperative music on pain, anxiety, and physiological parameters after surgery in patients receiving a surgical intervention in local or regional anesthesia, compared to patients receiving general anesthesia. Perioperative music reduced pain, pain medication, anxiety, and blood pressure and heart rate in patients with local and regional anesthesia. The positive effect of music was lost for pain medication, systolic blood pressure, and heart rate in patients with general anesthesia.



(ES = -0.09, 95% CI -0.28 to 0.10) and was no longer statistically significant ($P < 0.03$) (Fig. 2). For anxiety, only one single study provided data with general anesthesia showing a positive effect.⁵² The positive effect of perioperative music on systolic blood pressure was present in patients with regional and local anesthesia (ES = -0.48, 95% CI -0.69 to -0.28), but not in patients receiving general anesthesia (ES = 0.04, 95% CI -0.35 to 0.41) (Fig. 2). Similarly, we found a positive effect of perioperative music on heart rate in patients with regional and local anesthesia (ES = -0.33, 95% CI -0.54 to -0.13), but not in patients receiving general anesthesia (ES = -0.05, 95% CI -0.26 to 0.16) (Fig. 2). There were, however, no differences in any outcome in the effects of music intervention between inpatient and outpatient settings.

Stratified Analysis for Self-selected Versus Preselected Music

Overall, the effects of music interventions on different outcomes were most often larger in studies with self-selected music by the respective patients (Fig. 3). Self-selected music was more efficacious on pain (ES = -0.35, 95% CI -0.52 to -0.17) than preselected music (by the study personnel) (ES = -0.26, 95% CI -0.53 to 0.01). Similar differences in ES were found for pain medication (ES = -0.34, 95% CI -0.65 to -0.03 vs ES = -0.19, 95% CI -0.37 to 0.00). The largest difference in ES was found for anxiety. Studies with self-selected music had a significant and moderate effect size (ES = -0.47, 95% CI -0.61 to -0.33), but studies with preselected music failed to show an effect on anxiety (ES = -0.06, 95% CI -0.44 to 0.32). No meaningful difference was found on blood pressure between studies with self-selected (ES = -0.37, 95% CI -0.60 to -0.15) and preselected music (ES = -0.45, 95% CI -0.84 to -0.05). Similarly, the magnitude of the effect of music on heart rate was comparable between self-selected (ES = -0.26, 95% CI -0.43 to -0.09) and preselected music (ES = -0.24, 95% CI -0.62 to 0.14).

Narrative Review on the Impact of Architectural Features, Interior Design, or Ambient Features on Patients' Health

We found very few studies on the effect of different art forms on surgical patients beyond music. We performed a narrative review on art in other patient groups looking for a broader picture of the potential effect of different art forms on medical patients. We adapted the art definition from the study by Harris et al,¹² including architectural features, interior design features, and ambient features. Architectural features are rather permanent characteristics, such as the spatial layout of a hospital, room size, and window placement. Interior design features are defined as less permanent elements, such as furnishings, colors, and artwork. Ambient features comprise lighting, noise levels, odors, and temperature. We assume that the positive effects of art on anxiety and pain are caused by positive distraction, which should affect surgical and nonsurgical patients in a similar way.

Regarding architectural features, providing a spacious, friendly, light-flooded hospital architecture may improve patient health, as measured by patient activity, pain, anxiety, and even mortality. Remodeled wards were able to improve socializing and lead to more active behavior.⁶⁹⁻⁷⁴ Such data were observed predominantly in psychiatric patients by observing behavior and a standardized checklist (Norristown Behavior Checklist [NBC]).⁶⁹⁻⁷² Furthermore, 4 studies showed beneficial effects of sunlight on perceived stress, pain, the length of stay, and mortality.^{13,75-77} In a prospective study on 90 patients with spinal surgery, sunlight decreased stress, pain, and the need for postoperative analgesic medication and eventually costs.¹³ A retrospective study on more than 550 myocardial infarction patients looked at the effect of sunlight exposure on patient outcome. Patients lying on the sunny side of an intensive care unit (ICU) had a shorter hospitalization time and even lower mortality rates (13.2% vs 7.7%, $P < 0.005$), as compared to the patients lying on the dull side of the same ICU.⁷⁷

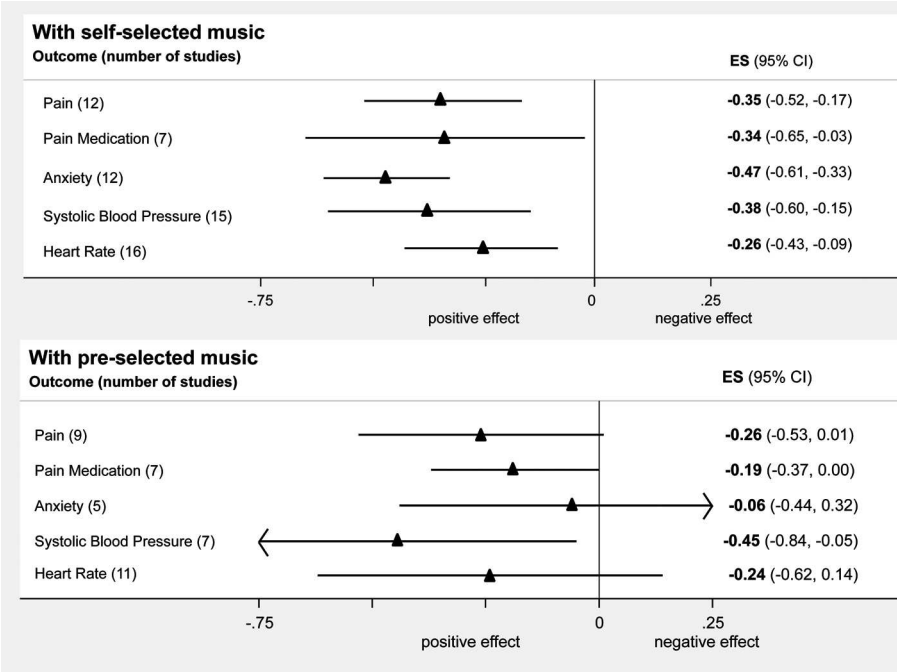


FIGURE 3. Personalized perioperative music increases the positive effect of music on pain, anxiety, and physiological parameters. This figure summarizes the findings of the meta-analysis on perioperative music on pain, anxiety, and physiological parameters after surgery in patients receiving a surgical intervention, depending on whether the music was self-selected or experimenter-selected. Self-selected music significantly reduced pain, pain medication, anxiety, and systolic blood pressure and heart rate. The positive effect of preselected music was limited to reducing the blood pressure.

Welcoming interior design for family members was able to improve patient support by their relatives on ICUs.⁷⁸ Regarding visual art, one study investigated patients recovering from open heart surgery exposed to a nature image, an abstract image, or a blank piece of paper. Patients exposed to the nature image experienced significantly less postoperative anxiety than the other 2 groups ($P < 0.01$). They were also significantly more likely to switch from strong analgesics to weaker pain killers during their recovery. Of note, the patients exposed to an abstract image experienced more anxiety than those with no image.⁷⁹ The positive effect of nature images was supported in a randomized controlled trial of patients undergoing flexible bronchoscopy.⁸⁰ Patients looking at nature themes had less pain than those looking at no theme.⁸⁰ Furthermore, “magic windows” presenting scenes from nature installed on the ceilings and walls in the waiting area and hallways increased patient satisfaction.⁸¹ The positive effect is, however, not limited to nature images. Several studies looked at the effects of different kinds of art on patients.^{74,79} In a retrospective evaluation on the impact of an art collection on patient mood, comfort level, and stress level, those

patients who noticed the artwork had improved mood, lower stress, and reported that the art collection positively impacted their overall satisfaction with and impression of the hospital.⁸² Interestingly, adding comfort as well as selected art work or “décor” to patient rooms⁸³ or waiting areas⁸⁴ also improved the satisfaction of patients with their physician, and also with their overall hospital experience.⁸³ No health outcome data were, however, reported.

Regarding color, there is no evidence that one single color affects our bodies and emotions in the long term.⁸⁵ Bright (illumination), saturated (vivid) colors of low hue (wavelength), like blue and green, however, elicit high levels of pleasure and low levels of arousal, and thereby may induce a state of calm.⁸⁶ This is supported by the observation that blue and green induce lower increase in heart rate and respiratory rate than red and yellow.⁸⁷

Of the ambient features, music has the strongest evidence for an effect on patients’ health. In addition to the positive effect of perioperative music on pain, anxiety, and physiological parameters, as identified in our meta-analysis, noise reduction has also been shown to have positive effects.^{88–91} In 94 consecutive patients on a



FIGURE 4. “Patient room” and “Viewing room” designed by Gottfried Honegger at the University Hospital Zurich, Switzerland. The left panel shows a color-redesigned patient room with grey ceilings and dark grey walls. The center and right panels show the mortuary viewing room. The color is held in light grey and complemented with a wall sculpture.



FIGURE 5. Hepatobiliary Center, Paul Brousse Hospital, Paris, France. The architects focused on opening the building to direct sunlight. Further, the building itself was curved to avoid long straight corridor perspectives onto the patient rooms.

heart ICU before and after applying sound-absorbing ceiling tiles, patients in the surrounding with sound-absorbing ceiling tiles woke up significantly less often ($P = 0.048$) and also rated the staff attitude quality significantly higher ($P = 0.004$).⁸³ Thus, noise, as intuitively expected, may have a major impact on how patients experience their ICU stay, and consequently noise reduction should be a priority.

Examples

As the last part of our study, we describe 4 examples from 3 different countries, as listed below:

- (1) In the Swiss Hepato-Pancreatico-Biliary (HPB) Center at the University Hospital Zurich, Zurich, Switzerland, several single bedrooms were redesigned by the internationally known artist “Gottfried Honegger” after he spent some time as a patient in the standard room with white walls. The artist belongs to the concrete art movement focusing on the virtue of simple

geometry and colors (<http://www.wikiart.org/en/gottfried-honegger>). The new rooms display mint green walls and blue ceilings (Fig. 4A). Over a 6-month period, each of the 62 patients who had stayed in these redesigned rooms for mainly pancreatic or liver surgery were asked a few questions by one of the coauthors of this study (Sr.U.) at the time of their discharge. Focus was on how patients experienced the new room at admission, postoperatively, and at the end of their stay. The patients rated the room color with increasing satisfaction over their hospitalization, and no patient stated that they would have preferred a white room. Gottfried Honegger also redesigned the mortuary viewing room, where blue and green colors dominate the main impression (Fig. 4B).

- (2) At the Centre Hépatobiliaire of the Paul Brousse Hospital, University Paris Sud, Paris, France, a new building was designed by “Claude Vasconi” in 1993 to offer novel architectural features to patients, family, and medical and nursing personnel. The vision of the architect was primarily “to diminish the anguish of patients and their families facing serious liver diseases, and waiting for major surgery or liver transplantation” (Fig. 5). The concept was to provide both patient privacy and space for encounters. Patient privacy was achieved by a curved building avoiding long straight corridor perspectives onto the patient rooms and by providing single patient rooms only. All patient rooms had very low windows enabling direct sunlight access and a view outside from the bed. Emphasis was put on inviting patients with family and friends to prevail on the common areas by adding a bookshop, cafeteria, and by displaying art in the form of sculptures and paintings in all public spaces.
- (3) The new hospital “Ospedale del Mare” in Naples, Italy, inspired by the architect “Renzo Piano,” was inaugurated in September 2015. The architectural structure follows modern principles of healing environments and focuses on maximizing the access of patients to daylight and outdoor spaces (Fig. 6). Emerging artists have been invited to expose their artworks (sculptures, paintings) within a 3-month rotation in the hospital corridors, the wards, and the outpatient clinic. The impact of art on patients’ well being will be routinely assessed with questionnaires.
- (4) The Istituto Clinico Humanitas was built in 1996 in the outskirts of Milan, Italy, and is surrounded by parks. The architects

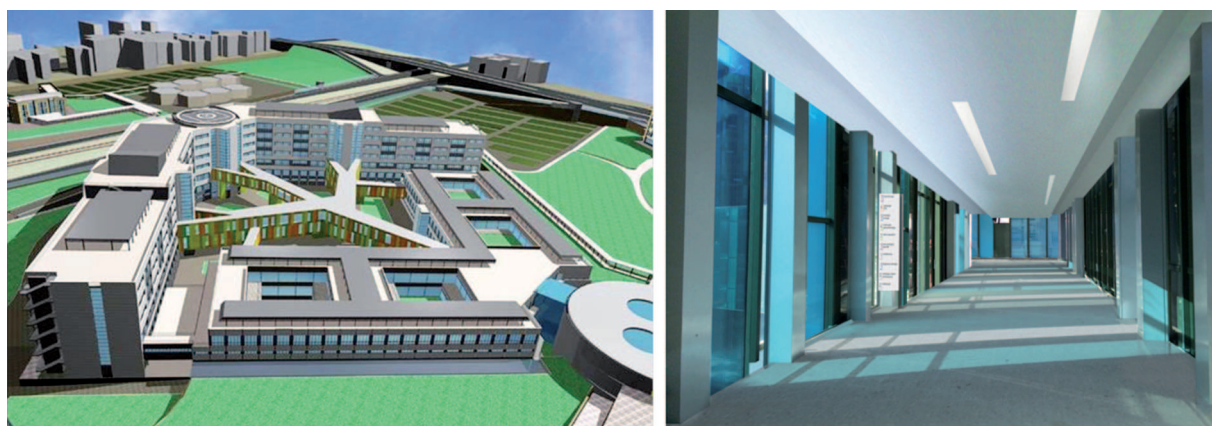


FIGURE 6. Architectural model of the Ospedale del Mare, Naples, Italy. The concept of the building is to maximize access to sunlight for patients, relatives and staff on the ward, as well as the common spaces. The circular building on the right is the foyer leading into the emergency department. The cylindrical building on the left contains the operating theaters. These can be accessed either directly from the ward or via connecting corridors running together in the center of the building, in a tree branch-like fashion.

“James Gowan” and “Renato Restelli” focused on providing sunlight access by windowed roofs and on creating a warm and pleasant atmosphere by applying a variety of colors to the walls. In addition, different art works of recognized artists and special art exhibitions were combined in several common areas of the hospital for patients, their relatives, and the working personnel (Fig. 7).

DISCUSSION

Although most health care providers might intuitively agree that being surrounded by art will positively affect patients, convincing data are scarce, and in reality, only a minority of patients are exposed to some sort of art. To our knowledge this is the first systematic review and meta-analysis looking at the evidence of the effects of art in surgical patients.

So far, the evidence of art in surgical patients comes mainly from studies about music. In 47 controlled studies, we found that music had a consistent positive effect on anxiety, pain, and physiological parameters, which was pronounced for self-selected music. Similar to world champions in sports like “Usain Bolt” or soccer world champions who listen to personalized music to improve their performance, with today’s technology, patients can self-administer their own music by own playlists from their smart phones. This way the effect of perioperative music can be maximized, is independent of music trends, and ultimately is cost-free for health care providers.

As for visual art, little is known about the effect of paintings and sculptures on patients. Stimulated by the positive patient rating of our color-redesigned rooms in the “Examples” section, we would like to speculate that visual stimuli by color and visual art may have a relevant impact on patient health. Evidence is, however, scarce. Multiple studies showed that nature images reduce anxiety and pain medication requirement. Interestingly, abstract art had a deleterious effect on postoperative anxiety and pain in one study. Thus, abstract art may not generally be considered as first choice for a hospital environment. We do not think this means that abstract art should be abandoned from the hospital environment in general, but that whether it is considered as a positive or even a negative distractor is probably very individual. We speculate that art that is not understood by the patient, which is more likely in the case of abstract art, might lead to an overall negative distraction.

Regarding architectural design, more spacious wards may allow better socializing by activating the patient to interact more with his or her surrounding and ultimately improve patient health. Architectural design providing sunlight has been shown to decrease postoperative stress and pain medication. Phototherapy is established in psychiatry when the positive effects of sunlight on depression⁹² are well known, but it is less known that surgical patients too may benefit from more sunlight.

Making structural changes to a hospital, however, whether during construction or refurbishment, is likely a costly undertaking. The case for investing in architectural features based on improved patient outcomes alone is not strong enough at this point, and would warrant further research on surgical patients in particular. Improved patient outcomes are not the only argument, however, for investing in good hospital architecture. For instance, the intent to reuse and also to recommend the hospital was significantly higher in patients lying in a more appealing room than those lying in conventional hospital rooms. Especially in light of increasing competition among hospitals as in many countries where mouth to mouth promotion has gained importance, providing appealing interior design and probably also architectural design may well be of financial interest for a hospital.

The allocation of financial resources to art, for example, in applying Gottfried Honegger’s color concept to the patient rooms at the University Hospital Zurich, can be challenging. Some evidence for a benefit on patients’ well being is important to justify investments in art. In a short survey of 23 mainly academic hospitals in Europe, Scandinavia, Russia, Asia, and the USA, we found that every third hospital invested into art at the time point the hospital was built, and every fifth allocates financial resources annually for art, but the budgets vary considerably between US \$8000 to \$74,000 per year. This means that art is in parts considered in the planning of hospitals, but it is far from being a standard in setting up a hospital environment.

Our study faces some limitations. First, our literature search was limited to the most recent publications of the past 15 years, and we might have missed conceptually important earlier contributions. However, our meta-analysis might give rather conservative effect estimates because early studies generally tend to overestimate effects or were only published with spectacular findings.^{93,94} Second, our findings are based on strong evidence for music and rather more scant evidence for visual art. Given the scarcity of studies looking at art in surgery, we also looked at art in medicine more generally. Third, the effects of our examples of visual art and architecture are not explored by extensive empirical data. Like in public health interventions, it is difficult to measure health outcomes on a population level because randomization on an individual level is challenging. Methodological sound studies with larger numbers of patients and an experimental design are possible, but still missing. Lastly, an important limitation of the overall topic of our review is “trends over time”: What is considered today as pleasant can be considered as old fashioned in the near future. Building up an ideal environment might become rapidly outdated. Therefore, changing environments, personalized visual art, and self-selected music interventions are reasonable approaches.

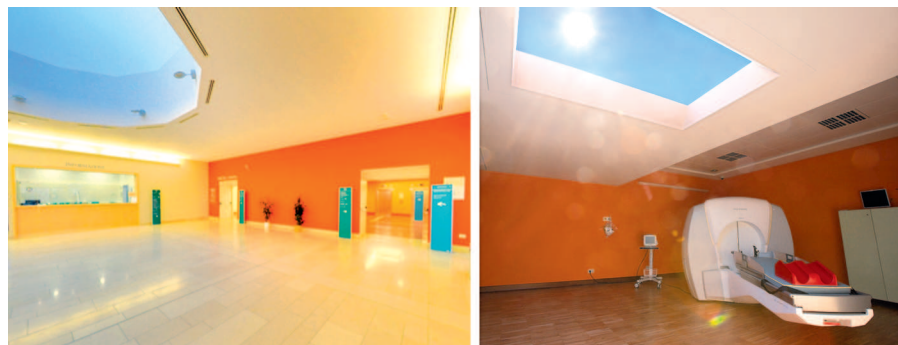


FIGURE 7. The “Entrance hall” and “Radiosurgery Gamma Knife ward” at the Istituto Clinico Humanitas in Milan, Italy. The entrance hall has a big skylight and the walls are kept in a warm orange. The CoeLux technology in the Gamma Knife ward maximizes the comfort for patients during treatments in the bunker by reproducing natural light, an image of the sky, and creating a virtual atmosphere of space.

In conclusion, our finding that art has an effect on patients' health seems obvious. It is also obvious, however, that this knowledge is not yet widely implemented in daily clinical practice. Based on our findings, we recommend personalized perioperative music for routine surgical care. Regarding visual art, evidence is still weak, although the effects are likely to be important with possible intervention at relatively low cost. Visual art, too, could be individualized to patients' preferences by using digitalized picture frames, or offering a rotating selection of art to hang on the walls. There is some evidence for a positive effect of architectural hospital design with maximized sunlight and spacious layout. Further, research looking at associated costs and effects is warranted.

ACKNOWLEDGMENTS

The authors thank Iara Meili for her support in the data extraction and Philipp Vetter for his critical review and valuable input for the manuscript.

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DISCUSSANTS

E. Barroso (Lisbon, Portugal):

Thank you Dr Vetter for presenting such an innovative topic for our special ESA lecture. We all agree that surgery has an important physical impact on patients and causes psychological stress. “Art Meets Surgery—A Systematic Review and Meta-analysis of Potential Healers” arduously attempts to prove evidence based on common sense. The more a hospital resembles home, the more modern, pleasant and functional it is. In short, the less a hospital looks like a hospital, the better the patients and their families will feel. Is it fair to attempt to prove the obvious? Are the out of reach (for a mere surgeon as myself) materials and scientific methods used valid to draw conclusions as the authors did?

Given that they are, should the emphasis of a costly hospital construction be put on the comfort and well-being of the patient? Or

on the well-being of the staff and on decreasing medical stress, thus reducing medical error and hospital-acquired infections, which are responsible for more annual deaths than car accidents or even breast cancer in the U.S.?

The impact of daylight, especially on ICU patients, is well documented. The importance of music during the postoperative period in the surgical ward is today easily replaced, as patients possess their individual portable devices. Actually, it remains unproven if “art” itself, represented by paintings and sculptures displayed in the surgical ward, contributes in any way in patient recovery.

Furthermore, we have to take into account the psychological and cultural dimension of each patient. Today, even with multidisciplinary teams that include a psychologist or psychiatrist, it is difficult to fully evaluate each patient in the pre-operative period. When investing the patient’s cultural background and preferences, it would be ideal if we could assess if he or she would benefit from music (and eventually which kind), favorite painters, etc. Our vast experience in the transplantation field, mainly liver transplantation, allowed us to become aware that patients highly differ when it comes to dealing with the aggressiveness of their surgery. This emphasized the need for intense psychological or psychiatric evaluation and allowed us to know beforehand and try to anticipate the different needs of care immediately after a patient leaves the ICU. Unfortunately, psychological preoperative evaluation by a specific professional is only exceptionally done in patients not submitted to a liver transplant. It is the surgeon’s responsibility to evaluate the patient’s psychological status.

Ulrich’s study, published in *Science* in 1984 and cited in your paper, which evaluates the effect of the window room view in the postoperative period of a cholecystectomy in terms of the need of painkillers and early hospital discharge, makes no sense nowadays. Currently, a cholecystectomy is mainly done in an ambulatory regimen and if not, the patients are discharged within 24 hours without the need for heavy analgesics. We should obviously extrapolate these conclusions to more complex surgeries.

In conclusion, the paper’s title is ambitious as it includes the term “art.” There are too many aspects of “art” that can be included in this manuscript. The influence of art is not specific for surgical patients. It impacts on diverse specialties. When building a hospital we must bear in mind it has to last up to 5 decades and besides the architectural and design features, it has to contemplate aspects such as exterior view and daylight, pleasant colors and even the possibility of ensuring personal preferences of patients (music, art, etc.). This

paper is significant as it highlights the importance of a good patient recovery that can be taken into account when building a great infrastructure such as a modern hospital.

Response From D. Vetter (Zurich, Switzerland):

Professor Barroso, thank you very much for your thoughtful and constructive comments. While our findings are indeed intuitively expected, validation throughout the literature is grossly missing. As academic surgeons we are used to recommending implementations of any intervention when evidence supports a benefit. We have shown in our extensive search of the literature that the use of art is effective. Music can be routinely implemented given the fact that it’s almost cost-free. Indeed, many forms of visual arts are at a low cost, while architectural features may require significant financial investments and planning.

Our systematic review and meta-analysis provides the strongest evidence currently available supporting the effectiveness of a variety of art features in surgery and hospitals as a whole. Additionally, our meta-analyses go beyond simple testing of a “yes or no” by providing pooled effect sizes (ES). For example, the use of preoperative music after a variety of surgical procedures disclosed greater anxiolytic effect than preoperative benzodiazepines, as shown in a large randomized controlled trial (Bringman H, *Acta Anaesthesiol Scand.* 2009;53:759–764).

Our search also indicates that further studies are necessary to validate expenses in architecture for the patient’s benefits in terms of faster recovery or improved wellbeing. We would like, however, to emphasize the fact that improvement documented through any metrics cannot be the sole argument. We mention the citation by the designer and author Don Norman, “Aesthetic matters. Attractive things work better.” Such a subjective statement is qualitative and cultural, with no desire to quantify the impact with p values. It is also no surprise that 2 of our examples came from Italy, and one from Paris. This probably has to do with personal and societal values. We would speculate that hospitals with artistic components bring joy and life. Natural light triggers positive feelings with perhaps a higher tolerance to suffering. Such hospitals will likewise be strongly recommended by patients, families and others. Thus, this may well eventually translate into financial incentives for the hospital.

Our group enjoyed very much working on this topic and we will embark in new studies and study design to evaluate various aspects of art in medicine. Finally, we must thank the council of the ESA for selecting our work for this special lecture.